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A PHOTOGRAPHIC FILM PROCESSING SYSTEM CONCEPT AND PROPOSAL

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20 March 1968

GENERAL

At present, the processing of aerial films, both originals and duplicates, is performed in equipment which has not changed greatly in concept over the years. Essentially, all such equipment use "wet" processes requiring the mixing of chemicals, complicated equipment, skilled personnel, and large quantities of water and power. In addition, there are several time-consuming operations involved in the production of duplicates.

This problem is recognized and defined in the Air Systems Command Technical Objective 93407 (TOD 69-34), a copy of which is attached as TAB A. Thus, if a suitable processing system could be devised to provide a transportable near-dry processing system providing the highest quality product in a fraction of the time presently utilized, it seems to us that such a system would have wide application in ~~both the Air Force and Navy~~ ALL THREE SERVICES. Such a scheme would appear to be particularly attractive to the Navy for use aboard ship where fresh water is usually at a premium.

To establish a facility for producing quality material, such as

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25X1A [redacted] entails a large initial investment as well as a continuing

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cost for maintenance of operations. One of the main problems is that regardless of where the film is recovered in the western Pacific, as example, it must be transported to this facility for quality processing. The downloading of the film from the aircraft to a local packaging facility, transporting of the film to the processing site, unpackaging the material and processing it all requires considerable time. We and others have felt for a long time that there should be some suitable system for quality processing film at the aircraft recovery site where a small team of P.I.'s could produce the immediate photo intelligence report in the minimum of time. Since many recovery sites conceivably would not have the water source or power available to operate a conventional system, we searched for some approach which would permit a virtually dry processing system. After reviewing the various on-the-shelf materials available as well as several systems either in development or research, we decided that a good place to start should be the use of Eastman Kodak Bimat film involving the Diffusion Transfer Process. In this process, chemicals are carried in the emulsion of a film material and brought into intimate contact with the exposed but unprocessed negative. After a short period of time to allow the process to go to completion, the two materials are separated. This results in (1) a processed high quality negative film and (2) a positive transparency in the Bimat film. Both materials, however, contain residual chemicals and are slightly tacky. The only solution that Eastman has applied commercially to date to eliminate the tackiness so the film may be

handled, is to put a clear sheet of material over the Bimat film and either apply a clear sheet of film over the processed negative or wash and dry the film in a conventional manner. The disadvantages with the latter are that the negative with the cover laminate impressed on it cannot be used for suitable printing, and that if the film is conventionally washed and dried, too much time is spent in producing a useable negative. Therefore, we insisted in our specifications to Eastman that some other approach be taken to provide a dry, original negative without either the laminated cover sheet or the conventional wet processing involved. In response to our requirements, Kodak produced what they have labeled "Desimat Tape." This is the most significant new item produced for this proposal and is mostly responsible for making it work. The tacky

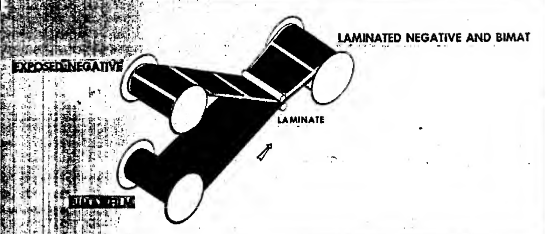
FOOTNOTE: Though Bimat is not new, there were those among us who were skeptical about its ability to produce a high quality negative. To satisfy all concerned, we used a regularly-scheduled training mission in the U-2 from the Edwards Detachment and employed the Delta II camera system. We had the forward camera film developed at Edwards on a Versamat processor, asking for the best job they could perform. The aft camera was forwarded to Eastman Kodak for Bimat processing with conventional washing and drying. The two films were then delivered to NPIC for an evaluation and ultimately to Eastman for an evaluation. The conclusions reached were that Bimat can produce a negative at least equal in quality to conventional processing.

film, having been processed, is brought into contact with the Desimat Tape and reeled together on a single reel. After a suitable period of time, at least 15 seconds, the process may be reversed and the Desimat Tape delaminated from the original negative, providing a dry, partially cleaned, processed original negative from which prints and duplicates can now be made. Two items should be noted at this point: (1) that this original negative is not archivable at this stage and (2) that the image will deteriorate after a period of time unless steps are taken to permanently fix the film in a conventional manner. This is not of particular significance, since the film can be handled without measurable deterioration for a week or more, then permanently fixed at a conventional laboratory later if need be.

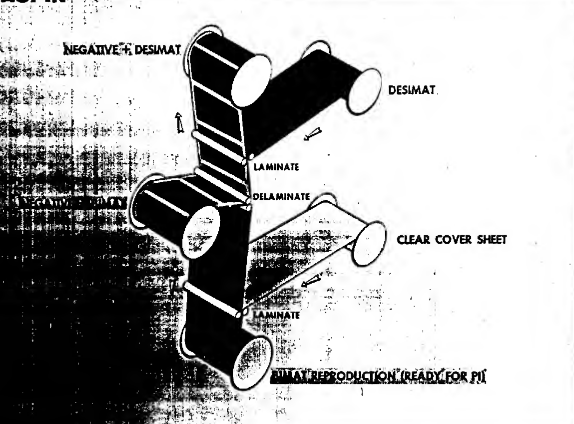
Thus far, it is conceivable that the film can be processed without large quantities of chemicals or water. However, the photo interpreter needs a high-quality dupe positive for his work, and a method had to be found whereby the dry, original negative would be employed in dry-processing such a positive. Eastman has developed what they call Drimat film, which is not dissimilar from the Bimat, since it contains a chemically-imbibed processing emulsion. However, unlike Bimat film, Drimat develops little or no density within itself. Drimat thus provides an ideal material for the rapid processing of exposed printed duplicates since the clear Drimat film supplies the processing agent and simultaneously acts as a clear cover sheet for the exposed duplicate stock film material. Eastman has designed

PROCESSING CYCLES AND REPRODUCTION TECHNIQUES

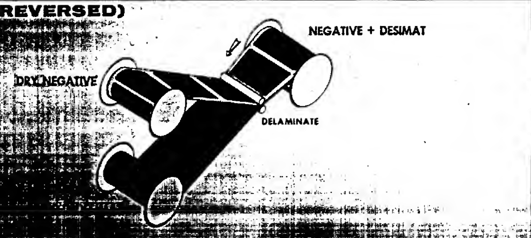
TRISPIN 1



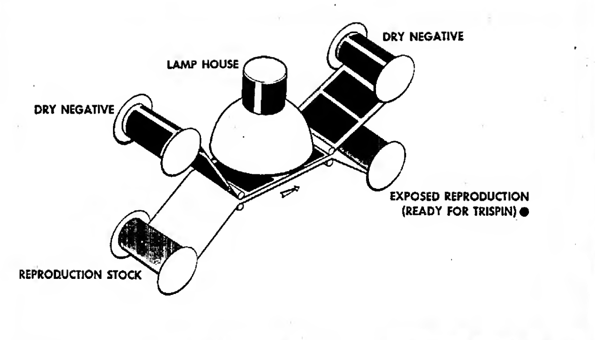
PENTASPIN 2



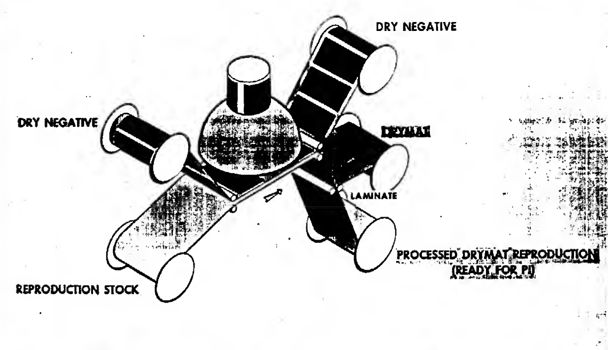
TRISPIN (REVERSED) 3



NIAGRA PRINTER 4A



DRIAGRA PRINTER 4B



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● TO MAKE ADDITIONAL DRY, UNLAMINATED POSITIVE REPRODUCTIONS: USE EXPOSED, UNPROCESSED REPRODUCTION FROM NIAGRA PRINTER IN PLACE OF THE NEGATIVE IN THE TRISPIN CYCLE.

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and proven part of the equipment to accomplish this unique processing system. The first piece of equipment developed is called a Trispin Machine, simply consisting of three spindles each capable of holding a film reel and with appropriate drive mechanisms. Two of the spindles are supply spindles holding the original negative and Bimat film. The third spindle holds the take-up reel which receives the laminated product from reels one and two. This same machine can be reversed after processing is completed on reel three, and the film delaminated and returned to reels one and two; however, as noted before, in a tacky condition. After the delamination has taken place, the Trispin can, by leaving the exposed material on reel one, substitute the Desimat Tape on reel two, and proceed with the lamination and delamination as noted above. This would provide on reel one, after delamination, a dry, unlaminated processed original negative ready for use in production of duplicate positives. Also, the Bimat film can be handled in the same manner, using the Trispin to laminate the clear cover sheet to the Bimat film. No delamination is necessary in this step.

To reduce the number of times the operator handles the original negative, a second machine was proposed, which has been informally referred to as a "Pentaspin." Here, the laminated Bimat and original negative material on one reel is inserted in the machine along with a reel of Desimat material and clear, laminate cover material on two other spindles. Spindles four and five act as take-up spindles for the O.N.

laminated to the Desimat and the Bimat laminated to the clear cover sheet. Use of the Pentaspin in conjunction with the Trispin would then provide the P.I. with a Bimat positive which he could use immediately for selection of charts, camera operation and exposure check, aircraft track determination, etc.

The Bimat positive is not of sufficient quality to perform quality photo interpretation; therefore, the original negative is used on a printer to provide high-quality dupe positives. This printer is similar to the conventional Niagara Printer, except that an additional spindle has been added to accommodate the Drimat film laminate material. Essentially, the printing process is similar to the conventional process in that the negative and conventional dupe stock material are brought together under a print light source, then recovered on two take-up reels. The Drimat film is laminated during the process to the unprocessed duplicate material after exposure and prior to final take-up and thus, the film is processed and cover sheeted in one operation. This so-called Drimat positive is immediately useable by the photo interpreter and is of at least as good quality as a dupe provided in a conventional wet processing system.

A brief recap of the materials used in this proposed processing system include an off-the-shelf Bimat processing film, the newly developed Desimat drying/cleaning tape, the recently developed Drimat material, the Trispin Machine, which Eastman is building on its own initiative since it realizes already the potential of this system, the Pentaspin Machine,

which has been described but not yet fabricated, and the Driagara Printer, which is simply a further development of the present Niagara Printer in use throughout many facilities today. All original negative and duplicate film materials are conventional on-the-shelf materials presently in use.

An additional specification which we felt particularly valuable to the IDEALIST and OXCART Programs would be that the whole system will be designed to be installed in a suitable shelter which could be completely transportable to the reconnaissance aircraft recovery site in a conventional military transport, such as the C-130 or C-141. This can be developed fairly easily we believe, incorporating all of the equipment in the trailer, measuring 8 x 8 x 24 feet with one or more self-contained refrigerating units measuring 8 x 8 x 9 feet each.

Further explanation of how this system functions can be noted in the advantages and disadvantages of the complete system. Some of the more apparent advantages are:

1. <u>No local chemical mixing required</u>. Transportation of bulky chemicals is eliminated and equipment and water necessary for solution preparation are not required.

2. <u>Required equipment is compact and simple</u>. Machines operating at 100 fpm or faster occupy less floor space than a conventional desk.

3. <u>Maintenance is simplified</u>. Infrequent maintenance, comparable to Niagara Printer maintenance, is required. The constant care required by wet processing machines is minimized.

4. The processes are relatively independent of ambient temperature and time. Close control of ambient temperature and humidity is not required. Hence, air-conditioning can be simple. Since the processes go to completion, time between operations in not critical (beyond a minimum).

5. Water requirements are extremely low. To insure intimate contact of the negative film and the Desimat tape, the film surface is dampened. This requires about one-half gallon of water per 100 square feet of film. As a corollary, no chemical waste disposal is needed.

6. Power requirements are low. Conventional equipment requires considerable power to drive many rollers and to pump chemicals. Even more is required to heat air for drying the film. These conditions are eliminated or minimized in this system.

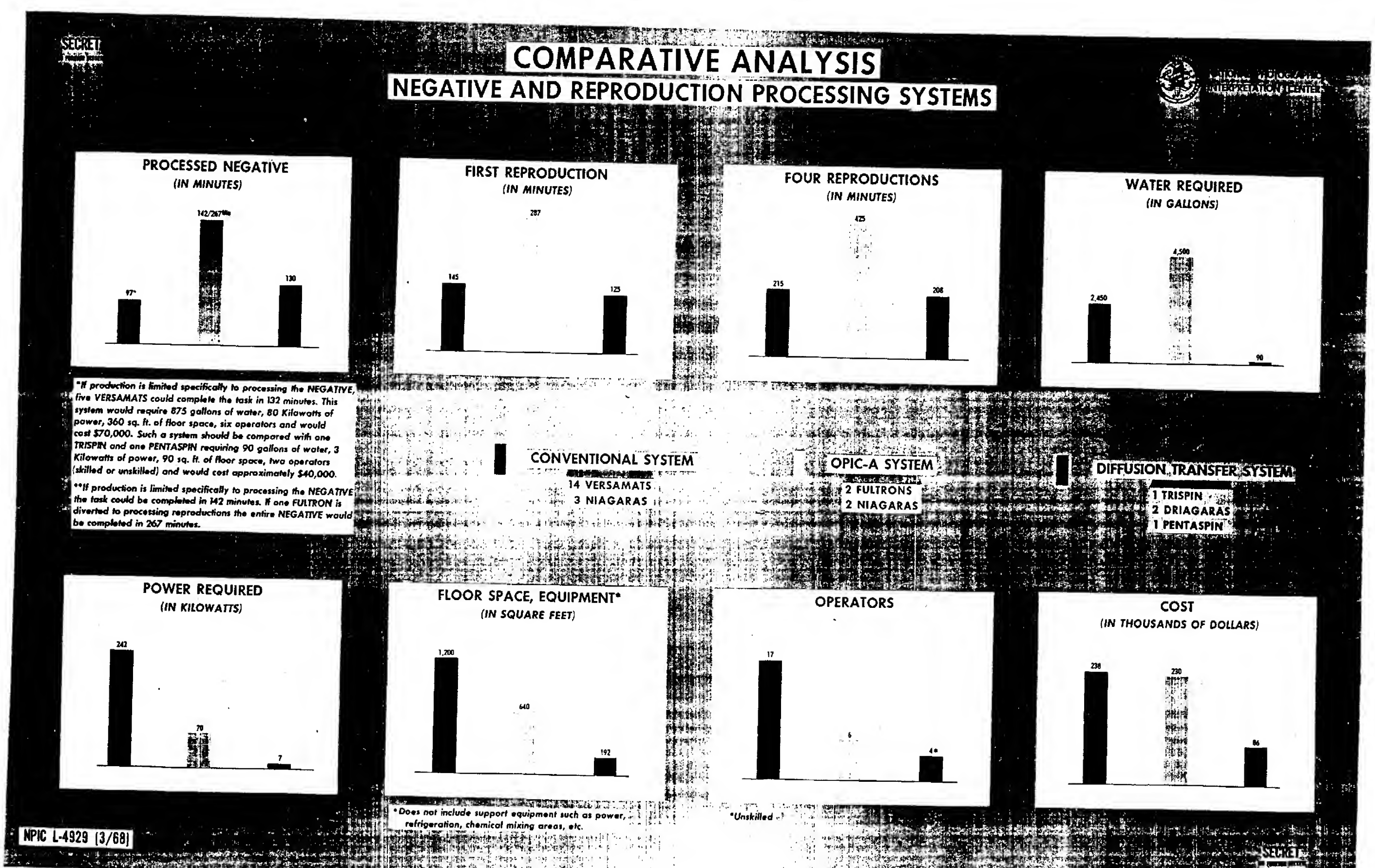
7. Independent of base facilities. Since little water and power and no waste disposal are needed, operation can be achieved almost anywhere by connection to a small (115 vac) power source.

8. Air transportable in a ready-to-use condition. All of the above add up to a layout which can be placed in a shelter or hut which is easily transported intact in conventional (C-130, C-141) cargo aircraft.

9. Reduced spare parts requirements. Since the machines are simple and use many parts in common, the spare parts support is greatly reduced and simplified.

10. Skilled personnel such as those used in conventional photo labs are not required. Very little instruction in the use of this compact and simple machinery is required. Little, if any, skill in photo-science is required, thus alleviating the frequent serious shortage of laboratory personnel.

The items listed above are distinct advantages of the Diffusion Transfer System when compared with a Conventional Processing System.


SECRET
COMPARATIVE ANALYSIS
NEGATIVE AND REPRODUCTION PROCESSING SYSTEMS
PROCESSED NEGATIVE
(IN MINUTES)
97*
142/267**
130
FIRST REPRODUCTION
(IN MINUTES)
145
287
125
FOUR REPRODUCTIONS
(IN MINUTES)
215
425
208
WATER REQUIRED
(IN GALLONS)
2,450
4,500
90
*If production is limited specifically to processing the NEGATIVE, five VERSAMATS could complete the task in 132 minutes. This system would require 875 gallons of water, 80 Kilowatts of power, 360 sq. ft. of floor space, six operators and would cost $70,000. Such a system should be compared with one TRISPIN and one PENTASPIN requiring 90 gallons of water, 3 Kilowatts of power, 90 sq. ft. of floor space, two operators (skilled or unskilled) and would cost approximately $40,000.
**If production is limited specifically to processing the NEGATIVE the task could be completed in 142 minutes. If one FULTRON is diverted to processing reproductions the entire NEGATIVE would be completed in 267 minutes.
CONVENTIONAL SYSTEM
14 VERSAMATS
3 NIAGARAS
OPIC-A SYSTEM
2 FULTRONS
2 NIAGARAS
DIFFUSION TRANSFER SYSTEM
1 TRISPIN
2 DRIAGARAS
1 PENTASPIN
POWER REQUIRED
(IN KILOWATTS)
242
70
7
FLOOR SPACE, EQUIPMENT*
(IN SQUARE FEET)
1,200
640
192
OPERATORS
17
6
4*
COST
(IN THOUSANDS OF DOLLARS)
238
220
86
*Does not include support equipment such as power, refrigeration, chemical mixing areas, etc.
*Unskilled
NPIC L-4929 (3/68)
SECRET

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It must be pointed out, however, that, while they by no means offset the advantages, there are a few disadvantages to the proposed Bimat System. The disadvantages are:

1. Refrigerated storage is required. Since Bimat and Drimat films are supplied as presoaked materials, it is essential that they be kept at a constant low (40-50°F) temperature from manufacture until just before use.

2. Processed camera film is not archival. The Bimat-processed film, however, is handleable and printable and can be made archival at a later date by conventional washing and drying if need be.

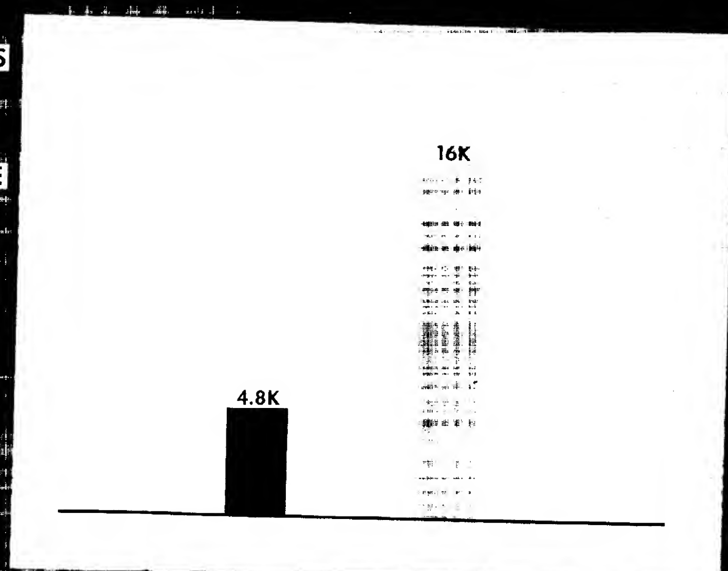
3. Drimat-processed positive duplicates are not contact reproducible. In the event that a duplicate negative is required, however, an exposed dupe positive can be processed by Bimat film (as was the negative), cleaned by Desimat tape and then printed conventionally to provide a duplicate negative. Drimat positives can be reproduced by projection printing.

4. The comparative cost of chemicals per mission favors conventional processing. (See chart next page). The cost of chemicals to conventionally process a 6000 foot mission and two dupes is 4.8K dollars compared to an estimated 16K dollars for the same mission using the Diffusion Transfer Process System. Some of the difference can be rationalized when it is recognized that the Bimat and Drimat are useable products and the Desimat tape can be processed and reused several times. In addition, we anticipate the costs of Bimat processing to be reduced substantially after equipment has gone into operation.

COST
(PROCESSING CHEMICALS)

BIMAT
CONVENTIONAL

REPRESENTS RELATIVE COST OF CONVENTIONAL WET PROCESSING VERSUS BIMAT PROCESSING. THIS IS COST OF PROCESSING MATERIALS ONLY FOR PROCESSING 6000 FEET ORIGINAL NEGATIVE AND MAKING THREE DUPLICATE POSITIVES WITH EACH METHOD.



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BACKGROUND DATA

As indicated in the preceding pages, the Systems Approach to the Diffusion Transfer Processing technique has become possible only quite recently with the development of new materials as well as newly designed equipment to exploit the new materials. The Specifications and Technical Proposal, which follows this section, is designed to satisfy a specific field application. The newly developed materials and associated equipment, however, should have an impact over the entire spectrum of aerial reconnaissance processing procedures.

In an attempt to document this impact, considerable information on the Diffusion Transfer Processing System is attached as an Appendix. The Appendix contains a description of sensitized products involved, and describes, as well as diagrams, the equipment developed to use these materials properly. Sensitometric characteristics also are discussed in some detail with accompanying sensitometric charts.

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Handle via
Control System

PRELIMINARY SYSTEM SPECIFICATIONS
FOR
PORTABLE PROCESSING AND PRINTING FACILITY

I. GENERAL REQUIREMENT:

A portable processing and printing facility is proposed for use with operationally deployed reconnaissance systems. The facility shall have a capability to (a) produce a useable, archivable original negative from all operational cameras; (b) utilize existing camera film types presently available in the field; (c) produce a limited number of useable, non-archivable duplicate positives. The duplicate positives shall be of three classes: (1) adequate to evaluate camera mechanical performance; (2) adequate for field photographic interpretation efforts; and (3) adequate as an insurance duplicate for use in case of loss or damage to the original negative during subsequent handling and shipping.

II. TRANSPORTABILITY:

The total system, including basic supply of expendables shall be transportable in a C-130 aircraft; expendable resupply packages must be transportable in a standard commercial or military cargo aircraft.

III. SUPPLIES:

The portable system shall contain its own supplies of water, photographic materials, and electrical power; it shall operate with a minimum of electrical power (not to exceed 10 KW). Required electrical power shall be supplied by gasoline engine driven generators, supplied as part of the system (fuel shall be from field stocks).

IV. ENVIRONMENTAL CONTROL:

Air conditioning (cooling, heating, humidification, dehumidification) shall be incorporated, adequate for operation with a normal personnel complement in both tropic and arctic environments (if needed, separate kits may be provided for operation under widely different environments). Refrigeration, if needed for storage life, shall be capable of maintaining required temperatures during shipment, using aircraft or ground power.

V. PERSONNEL REQUIREMENT:

Operating personnel complement shall be four or less; operator skill requirement shall be kept to a minimum.

VI. CAPACITY:

The system shall provide a capability of processing types 3404, 3400, and 3401 original negative material, without detectable degradation below that provided by laboratory processing at a high quality fixed installation, (such as [redacted] with a capacity of up to 6000 feet of original film per day. Film widths of 70 mm to 9.5 inches shall be accommodated. Expendable supplies shall be carried for 14 days of operation; replenishment shall be in 14 day increments. Storage life of the expendables, under provisioned storage conditions shall be at least six months.

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VII. THROUGHPUT TIME:

The system shall be designed to complete processing and duplication of three duplicate positives (one of each class, Para I) from

an original 6000 foot roll within ten hours (from receipt of film in shipping container to delivery of material ready for air shipment).

VIII. GENERAL COMMENTS:

Photographic interpretation equipment or space is not to be provided, other than that needed for control and evaluation of processing. While titling is not currently an explicit requirement, the capability for including titling shall be considered. If the produced negatives and positives are not titled by frame, each roll must have titling information on head and tail. Cutting of the original film prior to processing may be considered, but it is highly undesirable; minimum increment for cutting is 1000 feet. Post processing cutting and print cutting may be done in any convenient lengths.

IX. SET-UP TIME:

The system is to be portable and need not be mobile. Total set-up time, from delivery to the operating site to acceptance of film for processing shall be twelve hours or less. No additional manpower, other than the operating personnel, shall be required for preparation of the facility for use, after placement at the operating location.

DEFINITIONS:

Archivable - Capable of being brought to standard photographic archival quality, after suitable final processing at central, high quality laboratories. Final processing may occur up to one month

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after original processing and after shipping in the usual uncontrolled environments experienced in air shipment.

Useable - Possessing the same or better characteristics as conventional processing, including resolvable detail (modulation transfer, gamma/granularity, etc.), speed, and latitude of exposure.

Camera evaluation quality - Adequate to determine mechanical malfunctions, adequacy of exposure, and similar factors influencing the useability of the camera for future missions, trouble shooting on malfunctions, settings of the camera to be used on future missions, and gross shifts of focus, etc.

Field photographic interpretation quality - (To be supplied)

Insurance duplicate quality - (To be supplied -- possibly does not need to be field processed).

Expendables - Include original negative stock, duplicate positive stock, processing chemicals and carriers, water, etc.

C-130 transportable requirement - In shipping configuration not over eight feet wide, not over eight feet high, not over thirty-six feet long, not over (to be supplied) pounds, not over (to be supplied) pounds per square foot loading. Shipping environment: (details to be supplied). Shock, acceleration, altitude, temperature, humidity, salt spray.

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Standard commercial or military cargo requirement - Not over eight feet by eight feet by eight feet, not over (to be supplied) pounds, not over (to be supplied) pounds per square foot loading. Shipping environment: As in C-130 above.

External environments - Tropic: Temperature, humidity, and ranges (to be supplied)

Arctic: Temperature, humidity, and ranges (to be supplied)

Desert: Temperature, humidity, and ranges (to be supplied)

Temperate: Temperature, humidity, and ranges (to be supplied)

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TECHNICAL PROPOSAL

GENERAL

This proposal will describe a portable processing and printing facility for use with operationally deployed strategic reconnaissance systems. The facility shall have the capability to (a) produce useable, archivable original negatives from all operational cameras; (b) utilize existing camera film types presently available; and (c) produce a limited number of useable duplicate positives. The duplicate positives shall be adequate (1) for evaluation of camera performance and exposure; (2) for field photographic interpretation efforts; and (3) as an insurance duplicate in case of loss or damage to the original negative during subsequent handling and shipping.

Subsequent sections of this proposal will elaborate upon these requirements and will describe in detail how these requirements will be satisfied.

SPECIFICATIONS

The processing facility must be portable, and contain its own supply of water, photographic materials and electrical power sufficient for a fourteen day operation. The operating personnel complement must be held to a minimum. The facility must be capable of operating in any environment. The system must be capable of processing up to 6000 feet of original negative and producing three duplicate positives, within five hours.

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The essential elements of these stated specifications are:

Transportability. The entire processing system, including a basic supply of expendables, shall be transportable in a C-130 aircraft. The resupply of expendables must be transportable in a standard commercial or military cargo aircraft.

Supplies. The portable processing system shall contain its own supplies of water and photographic materials. Expendable supplies shall be carried in refrigerated storage sufficient for fourteen days of operation. Replenishment of supplies shall be in fourteen day increments. The storage life of the expendables, under provisioned storage conditions, shall be at least six months.

Internal Environment. Heating, air conditioning and humidity control shall be incorporated in the shelter housing the processing equipment. This internal environment shall be adequate for all possible areas of operation, including arctic and tropic environments. If required, separate kits may be provided for widely variant temperature ranges. Refrigeration, where required for storage life of photographic materials, shall be capable of maintaining required temperatures during shipment, using either aircraft or ground power.

Personnel. Operating personnel shall be a maximum of four. In keeping with the relatively simple-to-operate equipment of the Diffusion Transfer System, operators training requirements will be minimal.

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Daily Workload. The system shall provide a capability of processing film types 3404, 3400, and 3401 (or equivalent) original negative material. Film width of 70mm to 9-1/2 inches shall be accommodated. The footage capacity shall be 6000 feet of original film and three duplicate positives.

Power. Electrical power may be provided from Base sources or from portable engine-generators. Total power requirement for the processing equipment shall not exceed 10 KW. To this must be added the power necessary to heat and/or air-condition the shelter under the selected operating conditions (arctic to tropic).

Interpretation Equipment. While neither photographic interpretation equipment nor space for such equipment is required, viewing equipment for quality control and evaluation of processing results shall be included.

Processing Time. The system shall be capable of processing the original negative and producing three duplicate positives within a time span of ten hours. The alloted time shall be calculated from receipt of the exposed original film to delivery of the material for air shipment.

Identifying Data. Each roll of processed film shall have titling information on both the head and tail. The cost of providing a frame-by-frame titling capability shall be identified in terms of time, manpower, space and equipment required.

Site Set-up. The system's equipment shall be designed so as to require a minimum set-up time upon arrival at a remote location. Total

set-up time, from delivery to the operating site to acceptance of film for processing shall not exceed twelve hours. The set-up shall be accomplished solely by assigned operating personnel.

Dimensions. The facility, in shipping configuration, shall not exceed eight feet in height, eight feet in width, and forty feet in length. Eighteen feet of the length shall be reserved for two supply containers, whose measurements shall not exceed eight by eight by nine feet.

Weight. The weight of the complete shelter shall not exceed 12,500 total pounds nor 300 pounds per square foot. Resupply containers shall not exceed 10,000 total pounds each nor 500 pounds per square foot.

Climatic Conditions. The system shall be capable of operating in the (1) Tropics, with a temperature/humidity range of 57°-105°F and 60-92 RH; (2) Arctic, with a temperature/humidity range of -40° to +50°F and 62-94 RH; (3) Desert, with a temperature/humidity range of 39° to 106°F and 20-70 RH; or (4) Temperate Zone, with a temperature/humidity range of 21° to 95°F and 60-85 RH.

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Note: [redacted] used for Tropic Zone, [redacted] for Temperate Zone, Arctic and Desert data are guesstimated. These figures must be refined.

Electrical Power

The shelter and reefers normally will derive their 115-volt power from a 120-208 V, 60 Hz, 3-phase gasoline engine generator unit. The estimated maximum power demand is 10 kilowatts. To provide safety factor, a 20 KW generator will be supplied. This unit will be strapped down in the shelter during transportation.

Climatic Considerations

The built-in characteristics of the Diffusion Transfer Processing System recommend it for use under a variety of climatic conditions. By contrast with conventional processing techniques, this system can be used effectively over the full range of temperature and humidity in which operating personnel should be expected to function.

The Bimat and Drimat transfer processes will function normally in the temperature range of 65°F to 90°F. At the lower temperature, a modest increase in time may be necessary for the photographic processing to go to completion. At the higher temperature, alight shift in the resulting sensitometric characteristics is to be expected.

Relative humidity has no significant effect on the processing action. Under dry conditions, if there is to be a sizable delay in the Desimat treating of the negative film or the cover-sheeting of the Bimat positive film after these materials have been delaminated, the rolls of film should be protected from dry-out.

The imbibed Bimat and Drimat film rolls must be protected from freezing. Because of the chemical nature of the imbibants, this will not occur above $10^{o}F$. Below $10^{o}F$, ice crystals may damage permanently the hydrophillic layers of the materials and cause defects which are detectable in the negative and dupe film imagery following processing.

Excessively high temperatures will accelerate the aging process in the presoaked Bimat and Drimat films. Whereas a normal shelf life of six months or better can be expected when these materials are stored at $40^{o}F$ - $50^{o}F$, this life at $100^{o}F$ is measured in days.

If the shelter is to be used in Arctic climates, a modification kit must be made available for incorporation in the Heater/Air Conditioner unit. For use in Tropic or Desert climates, a separate air-conditioning kit must be made available to increase the cooling capability of the Heater/Air-Conditioning unit. This has been taken into account in the construction of the shelter, but is not a part of this proposal.

Quality Assurance

The Splicer/Viewer will be used for examining the cover-sheeted Bimat positive film to assure proper camera performance and exposure. The Splicer/Viewer also will serve as backup equipment for field photographic interpretation.

Titling

Preprinted leader/trailer film strands will be applied to each roll of film using the Splicer/Viewer equipment. Identification data will be placed

in the preprinted leader/trailer blanks with felt-tipped pens. This identification, together with preexposed consecutive numeric footage marker on the 6000-foot roll of O.N. material can assure reliable identification of the processed negative and duplicate film.

If frame-by-frame titling becomes a requirement, a Delaware titler can be provided. In this event, however, the shelter length must be increased to 24 feet and the equipment layout considerably modified. In addition, at least one more specially trained operator must be added onto the personnel complement. This would increase the total time to complete the mission to approximately 8 hours.

Personnel

Due to the simplicity of operating Diffusion Transfer equipment, a trained operator in the sense of conventional processing is not required. Naturally, all three operators should be familiar with each item of equipment installed in the trailer. A maximum of two weeks should be adequate to train an operator for this type of operation. Those designated as maintenance specialists would require an additional two weeks training.

Site Layout

Once the shelter has been removed from the aircraft, placed in its operating location and leveled, preparing the facility for operation is quite simple. The generator (lashed to the shelter floor for transportation) will be located outside, filled with fuel and connected to the power intake. Photographic materials are removed from the reefer and placed in the designated

area of the shelter. Since all equipment is secured to one or more bulkheads, removal of tiedown facilities is a matter of only a few minutes. In fact, the limiting factor to becoming operational is the time required by the refrigerated materials to reach ambient temperature. In no case will they require more than 8 hours.

Shelter Construction Data

The shelter, with overall dimensions of 8 ft. x 8 ft. x 24 ft., will be of metal-faced plywood exterior construction with 3-inch thick walls. One main door is provided, as well as two emergency exits. Removable wall panels allow the installation of the processing equipment.

The air-conditioning equipment retracts into the shelter interior for transportation. All electrical and air-conditioning duct work is located behind a 4-inch deep false ceiling and, where practical, within the shelter's exterior walls.

All interior partitions and appointments are of formica faced plywood construction including the storage shelves, pass-boxes, and light-tight doors.

It is estimated that the entire shelter, including installed equipment, will weigh 10,100 pounds. Floor loading will not exceed 300 pounds per square foot, using twelve-inch skids for support.

Reefer Construction

The two reefers each will measure 8 ft. x 8 ft. x 9 ft. long. The 2-inch thick metal faced exterior walls will be covered inside with 4 inches of insulation. The 6-inch walls plus the refrigeration unit results in a useable storage capacity of 337 cubic feet. Each reefer will hold a 7-day supply of photographic materials, and allows for maneuvering the materials in and out of the reefer. It is estimated that each stocked reefer will weigh 8800 pounds. Floor loading will not exceed 490 pounds per square foot, using twelve-inch skids for support.

REQUIRED MATERIALS

In addition to normal negative and dupe films conventionally used, four new materials, Bimat and Drimat films, cover sheet, and Desimat tape are required. Of these materials, the pre-soaked Bimat and Drimat films are critical to the proper development of the imagery on the exposed films. The quality of these materials is precisely controlled by the pre-soaking operation at the point of manufacture.

The pre-soaking operation is performed on machines not unlike conventional processing machines. A strand of dry film from a supply roll is fed through a number of tanks containing the premixed certified imbibant solutions.

Within reasonable limits, the amount of solution imbibed into the films has a decided effect on the ultimate processing results. This parameter is determined by the total time the film strand is in the imbibant and the temperatures of the solutions. Consequently, strand speed and tank temperatures are carefully controlled.

Packaging of pre-soaked materials consists of placing the finished roll in a flexible barrier-type plastic pouch, evacuating the pouch, and heat-sealing the open end. For shipment, the pouched rolls are placed in appropriate over-packing to provide mechanical protection.

During shipment of the materials from the point of manufacture to the point of use, and continuously thereafter until used, pre-soaked Bimat and Drimat films must be stored at 40-50°F, to insure a shelf life of 4 to 6 months. Materials stored beyond this time will suffer sensitometric

degradation which manifests itself as some loss in gamma and photographic speed together with an increase in fog level. These effects are gradual with time and not severe. The ultimate shelf life is determined by the degree of physical deterioration in the imbibed hydrophilic layer of the pre-soaked material. However, successful processing has been achieved with Bimat films stored at 40°F for a period in excess of one year.

Desimat tape and cover sheet are dry products and are shipped in rolls in a conventional manner.

SENSITOMETRIC CHARACTERISTICS

Figures A-7 and A-8 are sensitometric characteristic curves for Kodak aerial films of the Plus-X type and Panatomic-X type respectively, when Bimat processing in the wrap-up mode. Also on the figures are characteristic curves for these same film types when processed conventionally in a Versamat processor with MX-641-1 chemistry at a transport speed of 10 ft/min and at the temperatures noted on the figures.

As can be seen in the figures, the gamma of the Bimat processed films is lower than when these same films are processed conventionally. Concomitantly, the latitude of both films is considerably greater when Bimat processed allowing, therefore, the useful recording of a much wider scene luminance range. An increase in photographic speed is also realized with the Bimat process. The measured Aerial Exposure Index (0.5 gamma method) are tabulated below:

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AEL Values

Film	Conventional Process	Bimat Process
Plus-X Type	76	102
Panatomic-X Type	15	29

The somewhat higher net fog level in both cases is characteristic of the Bimat process.

The image quality (resolution, MTF, granularity) of Bimat-processed aerial type film is superior to that obtained when they are Versamat processed. It should be emphasized also that the sensitometric results obtained with the Bimat process are "locked in" and not subject to the usual conventional processing variables of solution concentration, strand speed, etc. Hence, specialized sensitometric skills and carefully monitored processing conditions are not required to achieve optimum and consistent results.

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Handle via
Control System

TYPICAL SENSITOMETRIC CHARACTERISTICS,

PLUS-X TYPE FILM

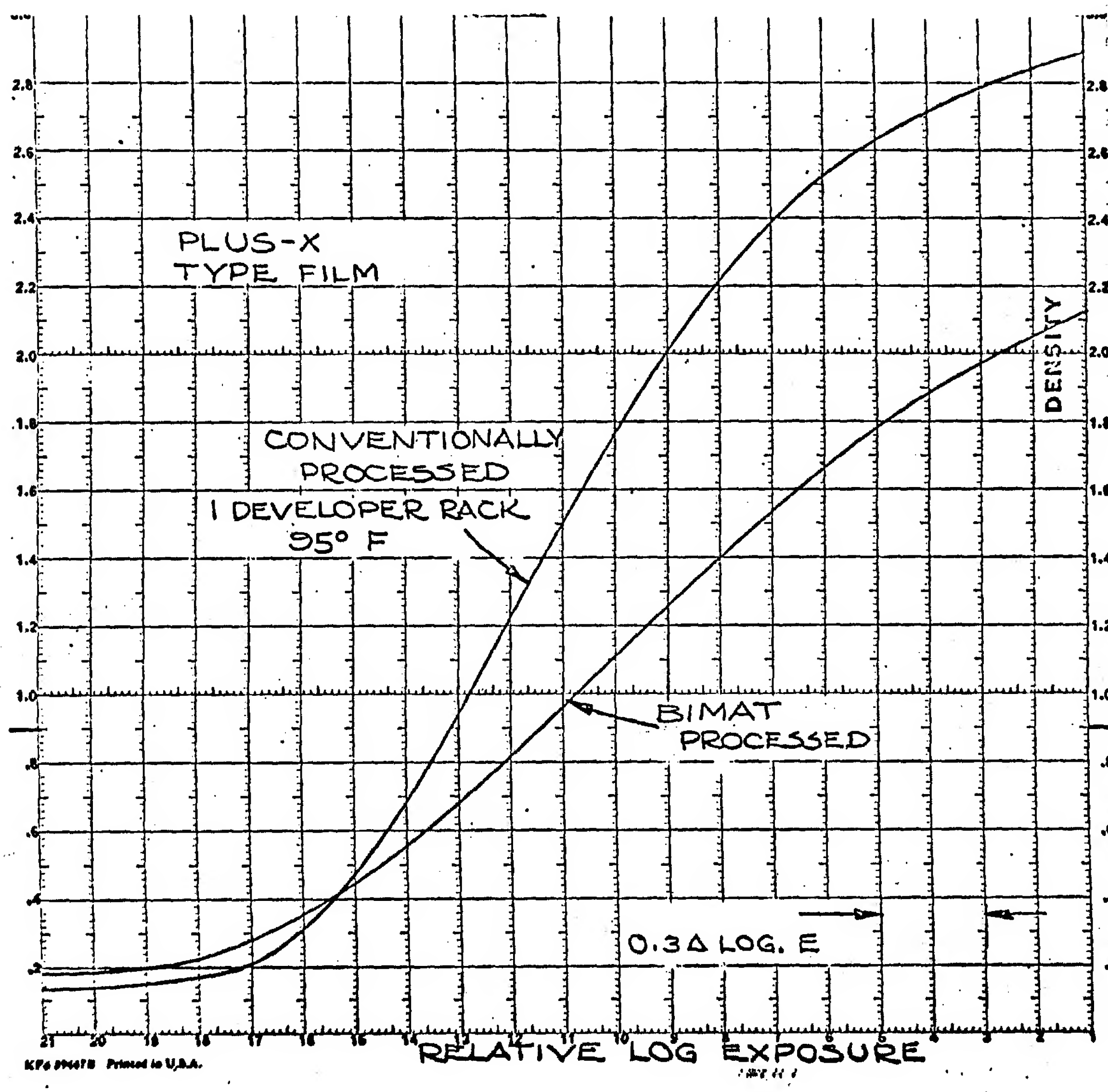

Figure A-7

TYPICAL SENSITOMETRIC CHARACTERISTICS,
PANATOMIC-X TYPE FILM

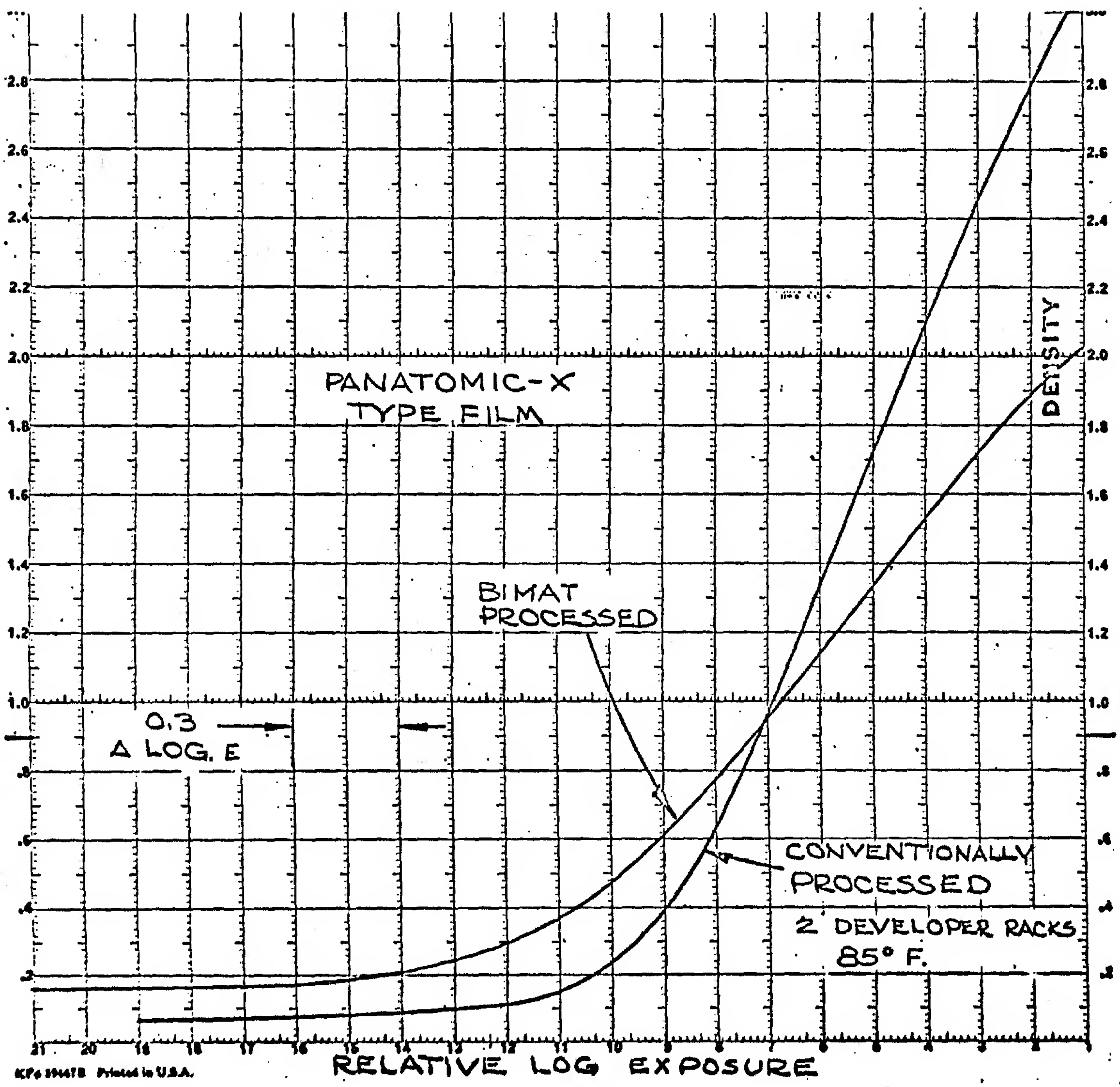

Figure A-8

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EMPLOYMENT CONCEPT

The obvious advantages of a transportable processor as described make it a very desirable asset to be used with Projects IDEALIST and OXCART. Where a detachment is deployed overseas on short notice to cover a crisis or near-crisis situation, the processor could be lifted to the operating site and significant information provided to the Intelligence Community and decision makers significantly earlier than presently available. The van could also be carried on the hangar deck of an aircraft carrier for the same support.

Present plans envisage one processing van located at the Edwards Detachment [redacted] The latter acquisition and implacement is contingent on the future of OXCART. The vans would each have two cold storage units as part of the processing system, and these would be kept ready for stocking and transshipment at Eastman Kodak, Rochester, on short notice. Both the processor and cold storage unit could be in place at the same time as the arrival of the detachment aircraft.

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Handle via [redacted]
Control System

DRY PROCESSING DEVELOPMENT PLAN

(All times cumulative unless otherwise noted)

		TIME	COST (ESTIMATED)
1. Engineering, design, fabrication and tests (prototype)	OSA/EK	10.5 mos.	
2. Final test and preparation for delivery to consumer	OSA/EK	12.5 mos.	
3. Field tests, training	OSA(DOD)		
4. Total cost of prototype transportable shelter including two transportable refrigerators and generators, ready for operational use:			
5. If complete duplicate shelter ordered with equipment installed and including two refrigerator units at time of initial order, second unit would be available: (i.e., 2 months later than delivery date of unit #1).		14.5 mos.	
6. Complete set additional equipment unsheltered*			
7. Three complete systems in shelter (as in #6), transportable units 2, 3, and 4:			

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Memo sent requesting to buy hardware less shelter and Diriagrai to

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*Does not include transportable shelter, transportable refrigeration units, generators, benches, tools, spare parts, etc. included in prototype.

RECOMMENDATION:

That the Office of Special Activities under the Deputy Director for Science and Technology, CIA, be provided funds for the development and test phases of one prototype processing van described.

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[redacted]
Executive Officer
Office of Special Activities

CONCUR:

Paul N. Bacalis, Brig. Gen., USAF
Director of Special Activities

Carl E. Duckett
Director, CIA Reconnaissance Programs

APPROVED:

Alexander H. Flax
Director, National Reconnaissance Office

TITLE

PHOTOGRAPHIC DATA PROCESSING UNDER COMBAT CONDITIONS

OBJECTIVE

1. GENERAL. To provide ground-based photographic data materials, processing equipment, and techniques for use under combat conditions.

2. SPECIFIC. To provide efficient, economical, and rapid ground-based chemical processing techniques and equipment which require little or no water and immunity to combat conditions. The equipment should be ground and air mobile and create no severe logistic problems.

PRESENT STATE-OF-THE-ART

Forward-line photographic ground processing and printing facilities frequently are seriously hampered by the lack of mobility, excessive down-time, and extensive setup time. Additionally, the logistics problems associated with the availability of chemicals and materials are further compounded by the need for large volumes of usable water for both chemical mixing and film washing. The problem of eliminating the need for large quantities of wash water is being attacked by water reclamation in the WS-430B system now under production. By use of mechanical means, such as the Versamat modification kit, the normal usage by the complex of 46 gal/min can be reduced to 19 gal/min. This method alone results in a savings of 41% over the normal usage. Size and weight of components and compactness of system require improvement. In processing techniques recent advances in diffusion transfer techniques, etc., have improved the water supply situation at forward stations. Other rapid processing techniques, including monobaths and stabilization techniques coupled with mechanical design advances such as the spinning drum applicator, have resulted in increased production rates and/or greater mechanical simplicity and compactness requiring minimum quantities of water. Printing techniques using diazo materials and processes have been developed which require no water for processing, yet which yield extremely high resolution imagery. Advances in light sources have resulted in more rapid diazo printing techniques beginning to approach silver halide techniques for rates better than 60 ft/min. The aforementioned processing techniques are equally applicable to silver halide and diazo reproduction materials, as well as original receptor materials. At present there is no color processing or reproduction capability of consequence in the field; however continuous processors are commercially available which operate 3-5 ft/min using 20-25 minute processing cycles.

TECHNICAL FORECAST

1. Investigations into rapid processing techniques using little or no water should be continued. Coupled with improvements in mechanical design, it is anticipated that essentially dry processing of high quality imagery at high production rates (equal to silver halide) may be achieved by 1970. Studies of techniques and devices for a complete "dry printing and processing" capability may be a possible means

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